

## ***Interactive comment on “Overview of the Nordic Seas CARINA data and salinity measurements” by A. Olsen et al.***

### **Anonymous Referee #2**

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#### General comments

The aim of the presented paper is twofold: to provide a general overview of the Nordic Sea CARINA database and to summarize findings of the QC of the salinity data. The high quality, internally consistent, released for public use database of hydrographic and hydrochemical parameters shall be extremely useful for the oceanographic community, in particular when the QC procedures and results are transparent and clearly presented. While the CARINA database has been established with the main focus on air-sea CO<sub>2</sub> exchange and marine carbon inventory, it also brings previously unavailable data sets suitable for assimilation into and validation of ocean circulation models, regional and climate studies, process studies and numerous other applications. To assure a wider use of the provided data it is essential that the database structure and all

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processing steps and applied techniques are reported in a clear and comprehensive way. The paper refers to a number of companion publications which are not yet available and due to that it is currently rather difficult to gain more insight into the details of data treatment, accounting for the presented adjustments and recommendations. Of the whole suite of the CARINA papers, two would be particularly helpful if preceding in the published sequence, the introductory paper by Key et al. (2009) and the description of quality control procedures and methods by Tanhua et al. (2009). It is my believe that all lacking information will be provided by the aforementioned papers, still I would like to suggest some improvements which would make the paper more suitable for stand alone use.

### Specific comments

Page 3 line 14: Should be 'The Arctic Mediterranean Seas include...'

Page 3 line 20: According to Fig. 4 and Section 4 the QC salinity data are consistent to 0.005

Page 6 lines 8-9: '...because they are more or less separate...' In which sense more or less separate? Locations, water masses properties? Please precise this statement.

Page 7 line 16: The data of OMEX1NS and Iceland Seas entries were collected during different cruises, using various instrumentation and processed by different analysts. Does it not imply different adjustments rather than the same ones for the whole entry?

Page 7 line 25: 'The latitudinal distribution of the data...' I suggest to add 'binned into 5° bands' for clarity, here or in the Fig. 2 capture.

Page 8 from line 9 on: Table summarizes the results of the secondary quality control. Four different recommendations are provided in this paragraph, labeled by numbers 1 to 4: using data as they are, using data after adjustment, not using data due to poor quality and no specific recommendation. However in the table, there is a mixture of flags (Flag 3 or NC) and numerical values of the recommended adjustments. Since in

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most cases the adjustments are 0 (when additive) or 1 (when multiplicative), they can be easily mistaken for a sort of flag. I would suggest a clear statement in the table capture that apart from flags NC and Flag3, the given numbers are values of individual adjustments, recommended for each cruise. And I would rather avoid using numbers 1-4 in the text when listing different cases, but instead put clearly in brackets that for the first case the constant (or factor) is 0 (or 1) and for the second case they are other than that.

Page 8 line 9: A consistency of the CARINA-AMS data product with GLODAP is underlined here as well as in the abstract. However, not all readers are entirely familiar with GLODAP and its quality standards. Thus it would be welcome to provide a sentence or two explaining what is covered by the GLODAP database.

Page 9 lines 8-9: Would be useful to provide a more detailed statement how the 1st level QC was performed, were outliers and obvious error identified just by visual control or any automatic screening has been applied?

Page 9 lines 20-22: The reference to Johnson et al. (2001) in the context of evaluating cruise-to-cruise differences in density space is not correct. In fact Johnson et al. recommended neither density nor depth but potential temperature space for crossover analysis, arguing that  $\Theta$  is the most accurately measured hydrographic quantity and is the natural coordinate for evaluating salinity due to the temperature-salinity relationship in the equation of state. The argument against using density in the Nordic Seas arises rather from keeping evaluation independent of errors in salinity which could result in density errors, not from the small density gradients in the area.

Page 9 lines 23-25: As mentioned by the authors, the convection depth in the Greenland Sea did not reach lower than 1500 m in 1990s (based on Ronski and Budeus, 2005 or ICES Report on Ocean Climate, 2008). Then I cannot see the point in taking into account only samples deeper than 1900 m, especially when a fraction of stations included in the Nordic Seas database is located outside the central Greenland Sea,

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in less deep areas. This criterion has a consequence in limiting a number of samples for crossover analysis. Perhaps the maximum depth criterion could be adjusted, depending on spatial distribution of crossover points. The same refers to the observed positive trend in salinity and other hydrographic parameters in the deep Greenland Sea over the last decade. The similar trend was not found in the other regions in the Nordic Seas and North Atlantic where the deep water mass composition is less affected by the deep outflow from the Arctic Ocean (see ICES Report on Ocean Climate, 2008) and projecting this positive trend onto the whole region seems not justified.

Section 4.1: Crossover and inversion analysis described here is the backbone of recommendation given for the salinity data from all Nordic Seas cruises. While I assume that a detailed description of the crossover procedures will be given in Tanhua et al. (2009) paper, it would be useful to provide at least basic parameters of the performed analysis in this paper. How were the crossover points defined? Which stations have been included in the crossover groups (in what distance from crossover points)? Were they the same as in Johnson et al. (2001), where the constant value of 200 km was used to designate crossover points and 350 km was used as a radius from a crossover point to define station clusters? The paper refers to the cnaX scripts used for evaluation of the salinity data. After exploring the CARINA website, I have not found any reference to cnaX scripts but instead the nice Matlab Crossover Toolbox which seems to have been used for the crossover analysis. From the Matlab scripts it is possible to find (among others) the interpolation method, definition of crossover points and crossover stations groups but these parameters should be described explicitly in the paper. The other question is how the matrix of weights was constructed for the evaluation of the salinity data. Does it reflect the larger influence of the Greenland Sea cruises on the salinity evaluation or another, region dependent weighting was applied? I strongly suggest to include more exhaustive description of the crossover and inversion analysis into this section, even if this might result in a certain overlap with the Tanhua et al. paper.

Page 13 line 4: There is no Fig. 3a in the paper, the sentence should refer to Fig. 3.

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## Technical comments

Fig. 3: The inlays with maps showing location of stations for each cruise are illegible in the present shape. As spatial distribution of stations is the crucial information for the salinity database, my suggestion is to move these maps to the side of the plots with salinity profiles and to increase size of these maps at least to equal the height of salinity plots.

Fig. 5: Similar technical remark as above. The colored bathymetry contours are not relevant for a comparison shown by these plots while positions of the 58JH19940525 cruise stations and those of other data used for crossover are. The marker size can be scaled in the M\_Map Toolbox and I suggest to use this feature.

Suggestion for the merged data set: Including time as a variable would help to distinguish multiple casts repeated at the same station. It would also not hurt to include the EXPOCODE cruise name as a variable in the merged data sets or at least to provide a separate file, matching cruise numbers with their EXPOCODE names for the cruises used in each merged data set. This information is required when using provided Matlab routines for reading the data and crossover analysis. Copying the text from the manuscript table is not the most convenient (but currently the only) way to get a subset of cruises used in the CARINA Nordic Seas merged data set in digital form.

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